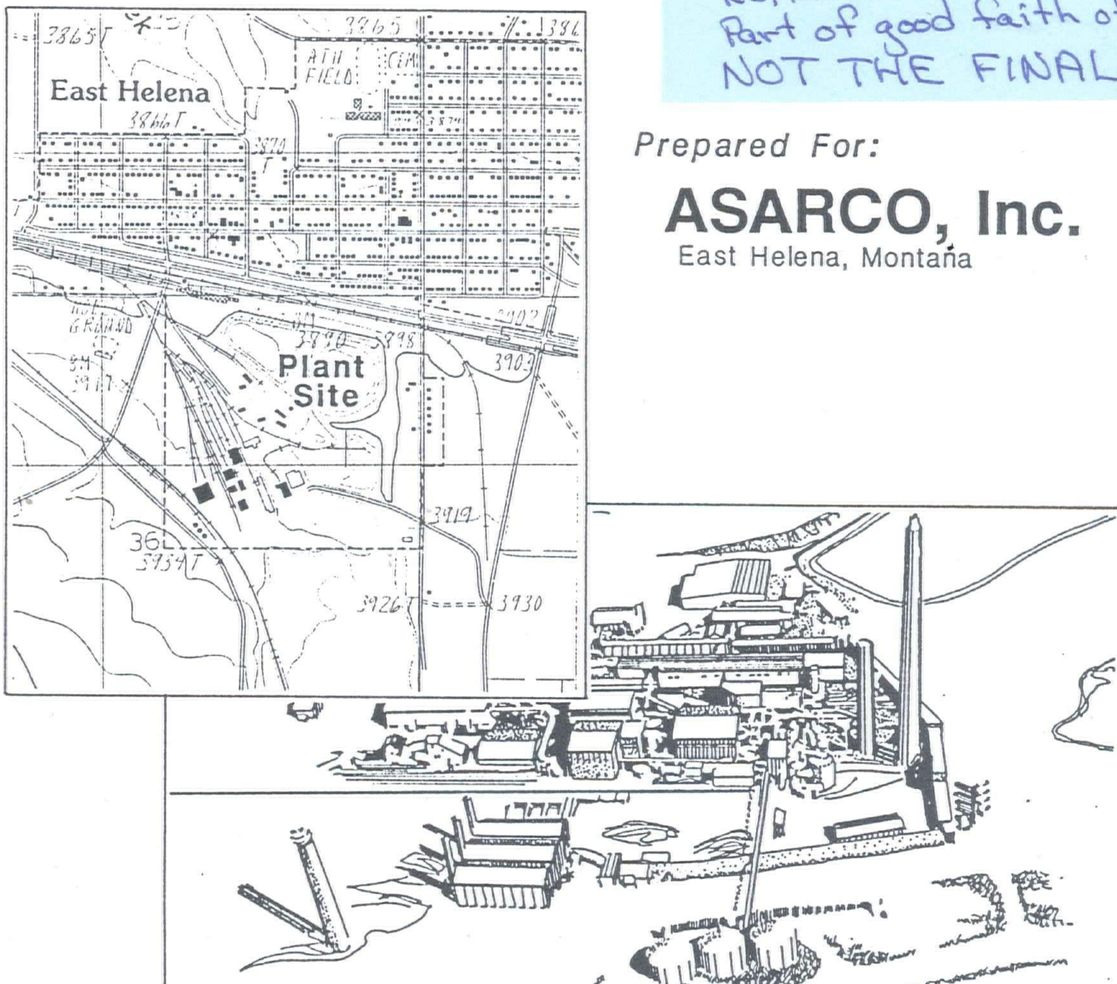
Comprehensive Work Plan For Remedial Design and Remedial Action ASARCO East Helena Site Process Operable Unit



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COMPREHENSIVE WORK PLAN
FOR REMEDIAL DESIGN AND REMEDIAL ACTION
ASARCO EAST HELENA SITE
PROCESS PONDS OPERABLE UNIT

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COMPREHENSIVE WORK PLAN
FOR REMEDIAL DESIGN AND REMEDIAL ACTION
ASARCO EAST HELENA SITE
PROCESS PONDS OPERABLE UNIT

1.0 INTRODUCTION

In November 1989, the Environmental Protection Agency (EPA) issued the Record of Decision (ROD) for the Process Ponds Operable Subunit for the East Helena Site. On February 23, 1990, the EPA sent a Special Notice Letter to Asarco, which requires Asarco to prepare a Remedial Design/Remedial Action (RD/RA) work plan for the Process Pond Operable Subunit.

This RD/RA Work Plan is based on the Statement of Work ("SOW"), which was attached to the Special Notice Letter. This RD/RA Work Plan is part of Asarco's good faith offer to conduct RD/RA activities for the Process Ponds Operable Subunit, which is to be attached to and incorporated by reference as part of the consent decree. The plan will be modified as additional RD/RA information is developed and in response to EPA review.

This RD/RA Work Plan for the Process Ponds Operable Sub-Unit will serve as the overall planning document for remedial design and remedy implementation. Related plan documents identified in the SOW are addressed in this RD/RA Work Plan. When completed, related plan documents will be attached as appendices.

1.1 SCOPE OF REMEDIAL ACTION

The Process Pond Remedial Investigation/Feasibility Study (RI/FS) and the ROD addresses four process pond areas:

1. Lower Lake,
2. The speiss granulating pond and pit,
3. The acid plant water treatment facility, and
4. Former Thornock Lake.

The selected remedies for each of the process pond areas, as established in the ROD, are summarized in Sections 1.1.1 through 1.1.5 of this Work Plan.

1.1.1 Lower Lake

Two 1,000,000 gallon steel tanks replace Lower Lake as the plant's primary water holding facility. The tanks comply with RCRA requirements and are designed with leak detection and secondary containment systems. Accumulated sediments are periodically suctioned out of the tanks and smelted. Construction of the tanks was completed in late 1989.

Data collected during the Remedial Investigation (RI) indicated the majority of process fluid circuit gain was groundwater from a dewatering drain near the former ore storage building. The purpose of the dewatering drain was to lower the local water table to control flooding of the former ore storage building. Remedial action will consist of removal of groundwater inputs from the main process fluid circuit, and the lower floor of the former ore storage area will be allowed to flood. Excess water gains remaining in the main process fluid circuit are principally from showers, sink drains, washdown water and freshwater bleeders. These sources will be eliminated or minimized wherever possible. The remainder will be evaporated using waste heat from plant processes or alternate techniques evaluated as part of the remedial design process.

Another component of the selected remedy for Lower Lake is construction of a double-lined pond in the northwest corner of the property for emergency containment of storm runoff. The pond will be sized to contain the 100-year, 24-hour storm event (assuming 95 percent paved conditions within the plant). The pond will include a primary geomembrane liner underlain by a secondary leachate monitoring and collection system, which is then underlain by another geomembrane liner. The storage capacity for the designed pond is approximately 4.75 million gallons. During the remedial design process, additional on-plant containment ponds or sumps may be considered.

Process waters in Lower Lake will be treated in-situ by the addition of ferric chloride and magnesium hydroxide to precipitate arsenic and metals. Treatment objectives for in place co-precipitation of arsenic and metals are given in Table 1.

TABLE 1. TREATMENT STANDARDS FOR IN-PLACE CO-PRECIPITATION OF LOWER LAKE PROCESS WATER (TOTAL METALS)

Element	mg/L
Arsenic	0.02
Cadmium	0.01
Copper	0.004 to 0.008
Lead	0.05
Zinc	0.11

Following in-situ treatment of Lower Lake water, the artificially deposited sediment and sludge layer (approximately 2 feet at the bottom of Lower Lake) plus an additional 2 feet of naturally deposited sediment will be removed by suction dredge. Sediments will be placed in a lined facility at the south or west edge of the plant for evaporative drying, or will be dewatered using mechanical methods. It is expected Lower Lake water will satisfy concentrations limits in Table 1, following in-situ treatment and sludge removal and, therefore, would not be removed.

Preliminary remedial design work conducted simultaneously with in-situ pilot scale water treatment testing suggests mechanical dewatering methods (for example, filter presses) may be appropriate to dewater sludge created by ferric chloride and magnesium hydroxide treatment (see Section 2.0). If a sediment drying area is implemented instead of mechanical dewatering, the drying area will comply with RCRA requirements. The drying area will consist of a concrete pad underlain by sand with a leakage detection and secondary containment system. Dried sediments will be temporarily stored and handled in a manner similar to ores to prevent fugitive emissions. Sediments will then be smelted as part of normal smelter operations.

1.1.2 The Speiss Granulating Pond and Pit

The speiss granulating pond was replaced by a RCRA-compliant steel tank installed with a leak detection and secondary containment system. Accumulated sediments in the tank are periodically suctioned out and smelted.

The existing pit is to be replaced with a RCRA-compliant watertight facility. The pit will be designed to drain by gravity to the speiss pond when the speiss pit is not in use. Accumulated sediments will be periodically suctioned out and smelted. The replacement pit will include a lined secondary leak detection and recovery system.

Soils underneath and adjacent to the remaining portion of the former speiss granulation pond, and the speiss granulating pit will be excavated during construction of the replacement structures and set aside for smelting. Prior to smelting, soils will be handled in a manner similar to ore to prevent fugitive emissions. Soil excavation objectives are based on EP toxicity leachate results. Excavation targets are to excavate soils with EP toxicity leachate concentrations exceeding MCLs or to excavate soils to the maximum practical limit of reasonably available backhoe equipment (approximately 20 feet). Excavation will include a 5-foot buffer zone where practical outside of the perimeter of removed portions of the pond and pit facilities. In some instances, the close proximity of existing facilities will preclude excavation of the full 5-foot buffer. In these instances, as much buffer will be excavated as is reasonably possible. Soil excavations will be preceded by additional soil core sampling to determine the extent of soil removal needed in the vicinity of the former pond and the pit.

Cobbles, boulders and gravel which are excavated will be separated from the finer grained soil, washed, and stored onsite. Remaining soils will be smelted.

Remediation of the speiss granulating pit will consist of installation of a temporary liner to immediately prevent fluid losses from the pit. Excavation of underlying soils and replacement of the pit will be implemented concurrently with dross plant renovations scheduled for 1992.

1.1.3 The Acid Plant Water Treatment Facility

The main settling pond, settling dumpsters, and sediment drying area will be removed and replaced with an enclosed, above ground mechanical separation system. The new system will include a filter press and surge tank, and will include leak detection and secondary containment features. Accumulated sediments will be periodically removed and smelted. The existing sediment-drying areas will be replaced by the mechanical filtration system (filter press) and will no longer be used.

Excavation of underlying and adjacent soils in the area of the treatment facilities will be implemented after existing settling basins and lines are removed. Excavation targets are soils with EP toxicity leachate concentrations exceeding MCLs or the maximum practical excavation limit (approximately 20 feet). In the sediment drying area near Lower Lake, sediments will be excavated based on leachate concentrations that exceed MCLs or to the groundwater table (about 7 feet). Additional soil core sampling at the acid plant water treatment facility will be necessary to determine the extent of excavation. Lime will be added to the excavation prior to replacement with fill to reduce mobility of arsenic and metal associated with acidic soils underlying the acid plant water treatment facility and sediment drying area.

Excavated soils will be temporarily stored and handled as ores prior to smelting. Cobbles, boulders and gravels will be separated from the soil, washed, and stored on-site.

1.1.4 Former Thornock Lake

Thornock Lake has been replaced with a steel tank which has secondary containment and leak detection. Bottom sediments from the former lake have been excavated, and smelted.

1.1.5 Contingency Remedy for Lower Lake Process Water

If pilot testing shows in situ Lower Lake process water treatment is not an effective remedy, a contingency remedy will be implemented for Lower Lake process waters only.

The contingency remedy will be a water treatment facility constructed to treat both Lower Lake water and process fluid circuit gains (if necessary). The water treatment facility will reduce metals and arsenic concentrations in Lower Lake process water and intercepted groundwater prior to discharge. Typical treatment will consist of removal of arsenic and metals by coprecipitation with ferric chloride and subsequent neutralizing by pH control. The required capacity of the treatment plant is estimated to be between 20 and 100 gpm.

Effluent from the process water treatment plant would be discharged to the East Helena Sanitary Sewer System, a Publicly Owned Treatment Works (POTW). Standards for discharge to the POTW will be developed before remedial design of an on-site treatment facility. It is anticipated that effluent discharge standards would be the same as existing standards for plant discharge to the POTW.

1.2 COMPREHENSIVE WORK PLAN COMPONENTS

Components of this RD/RA plan include remedial design work plans for all four process pond areas as well as the Lower Lake contingency remedy.

Additional related work plans scheduled for completion at a later date include:

- Site Health and Safety Plan
- Sampling and Analysis Plan (includes Field Sampling Plan and a Quality Assurance Project Plan [QAPP])
- Construction and Management Plan
- Lower Lake Process Water Pilot Testing Plan
- Design Plan for Separation of Cobbles From Excavated Soils
- Smelter Treatment Demonstration Design Plan
- Operation and Maintenance Plan

The related work plans will be added to the RD/RA work plans as appendices as they are completed.

Additional elements of this RD/RA Work Plan include:

- descriptions of the qualifications, responsibilities and titles of key personnel and/or organizations working on the Process Ponds RD/RA Project.

- a comprehensive schedule showing important site activity dates, deliverable due dates, contractor procurement dates, and other component time lines and schedules.

2.0 LOWER LAKE REMEDIAL DESIGN PLAN

The remedial design plan for Lower Lake process waters will be based on results of the on-going Lower Lake process water pilot testing and will include development of a detailed design for emergency containment of storm runoff. The interim and final reports on pilot plant testing are expected to be finalized May 15, 1990, and August, 1990, respectively, assuming no delays in obtaining equipment and chemicals which could cause a delay in submittal of the final report.

The Lower Lake Remedial Design plan also will be based on results of pilot testing of sludge treatment and handling methods. The pilot testing program for Lower Lake sludge will be developed if on-going pilot testing of treatment of Lower Lake water is successful. Data collected to date show treatment standards can be met using co-precipitation of arsenic and metals in Lower Lake process water. The anticipated pilot testing program for Lower Lake sludge is shown schematically in Figure 2-1.

Conceptually, the Remedial Design will address the following:

- <u>Water Phase</u>
  - Select float-mounted baffle systems and curtain walls to allow division of Lower Lake into manageable units. This will allow reuse of mixing, piping and chemical pumping equipment. In order to maintain a zero hydraulic head

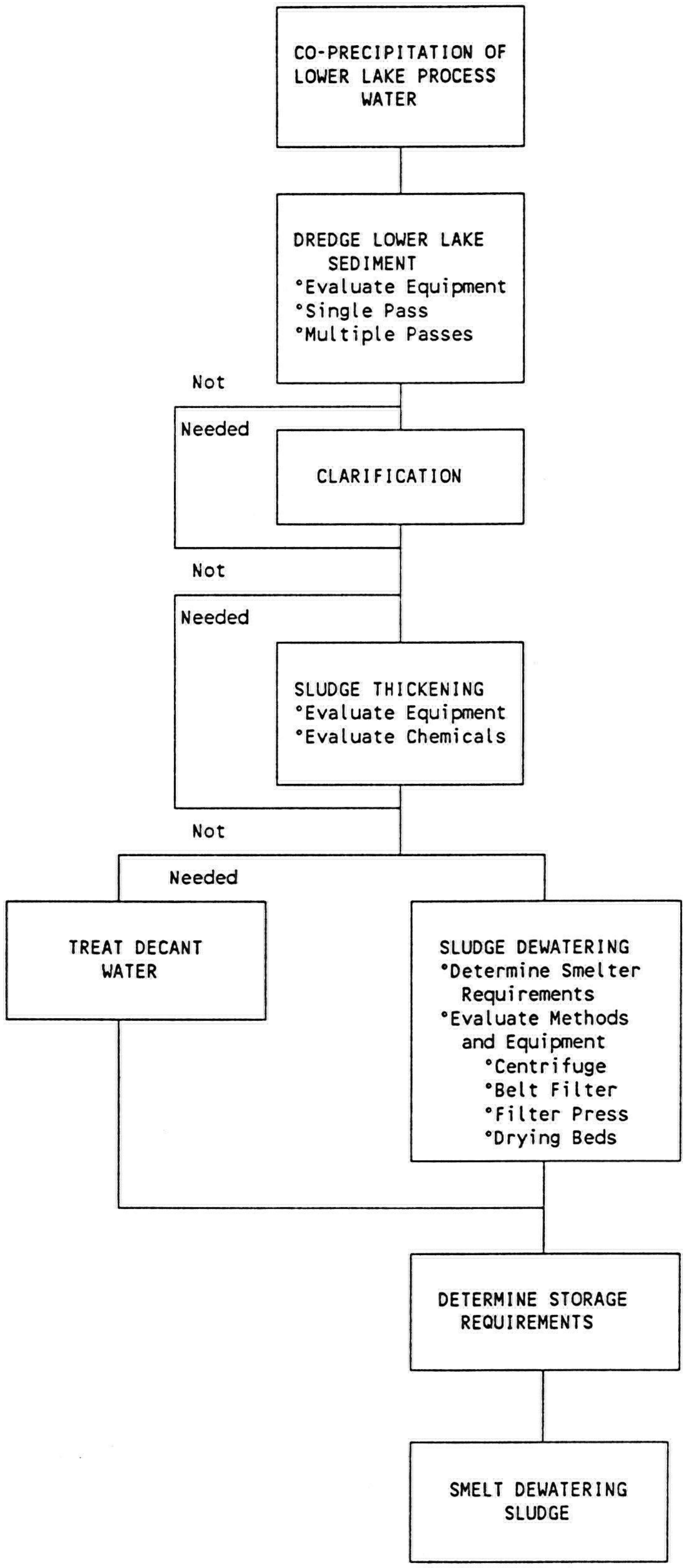


FIGURE 2-1. SCHEMATIC DIAGRAM OF LOWER LAKE SLUDGE TREATMENT AND HANDLING PILOT TESTING PROGRAM

differential between cells, no sludge will be removed until all of Lower Lake has been treated.

- Size selected for mixing devices. This will be based on pilot plant test results and manufacturer recommendations.

- Size and select piping and pumping equipment for $FeCl_3$, $Mg(OH)_2$ and polyelectrolyte additions. Chemicals must be dispensed uniformly and in reasonable conformity to pilot plant test procedures.

- Determine chemical requirements for each pond segment. Chemical requirements will be based on pilot test results.

- Sludge Phase

  - Examine types of dredge equipment. Because of the need to remove bottom sludges and sediments completely to a specified depth, an auger/tiller head dredge is expected to be the preferred type of equipment. Several dredge manufacturers have been contacted regarding equipment types and availability.

  - Examine clarification and/or sludge thickening equipment. This equipment will be sized to the selected dredge and is needed to allow efficient sizing of sludge dewatering equipment.

- Examine sludge dewatering. Requirements for sludge dewatering will be based on smelter considerations. Too much sludge with too high a water content can upset the smelter process. Mechanical sludge dewatering equipment and sludge drying beds will be examined.

- Sludge Storage. Because cold temperatures and strong winds are not desirable, it is anticipated sludge removal and processing will be initiated and completed within the period from late spring through early fall. Since the volume of sludge and sediments removed during this period probably cannot be processed at the same rate as they are removed, it may be necessary to design and construct interim storage facilities. Storage facility sizing requirements are dependent on allowable moisture concentrations. Maximum allowable moisture concentrations will be determined by smelter process considerations. Too much moisture in too much sludge could cause unacceptable cooling of the smelting process.

- <u>Containment of Storm Runoff</u>

  - Plant area topography generally slopes to the northwest which would allow plant runoff to flow by gravity to the proposed pond site. At some localized areas, such as Thornock Tank, topographic lows occur and it may be more practical to design and construct an intermediate tank or pond at this location than to regrade the site. Pumping facilities at the intermediate site could be designed to pump the intercepted water to the 4.75 million gallon containment facility at the northwest corner of the plant.

° If tanks are implemented as part of the 4.75 gallon containment facility, the stormwater containment tanks will meet applicable requirements.

° A stormwater containment pond would be constructed using a primary geomembrane liner underlain by a secondary leachate monitoring and collection system, which, is then underlain by a secondary geomembrane liner.

° The tanks or pond will be designed to contain all plant runoff from the 100-year, 24-hour storm event assuming 95 percent of the plant drainage area is paved.

3.0 SPEISS GRANULATING POND AND PIT REMEDIAL DESIGN PLAN

3.1 SPEISS GRANULATING POND

Remedial design and construction of the speiss granulating pond was implemented in the fall of 1989. The existing pond was replaced with a RCRA tank which includes a secondary leakage detection and containment system. Soils underlying the replacement tank were excavated to the maximum practical depth (approximately 20 feet), which was to the top of the water table.

The former speiss granulating pond was only partially removed. The remaining portion of the pond was retained for use as emergency overflow storage. EPA RD/RA objectives for the remaining portion of the speiss pond are excavation of underlying soils where EP toxicity leachate concentrations exceed groundwater MCLs or to a maximum practical limit of approximately 20 feet. Soil excavation will include a 5 foot buffer zone, if practical, outside the perimeter of the remaining portion of the former speiss granulating pond. In instances where existing structures and facilities preclude a 5 foot buffer, as much buffer as possible will be excavated.

The replacement tank and the remaining portion of the former pond are shown in Figure 3-1.

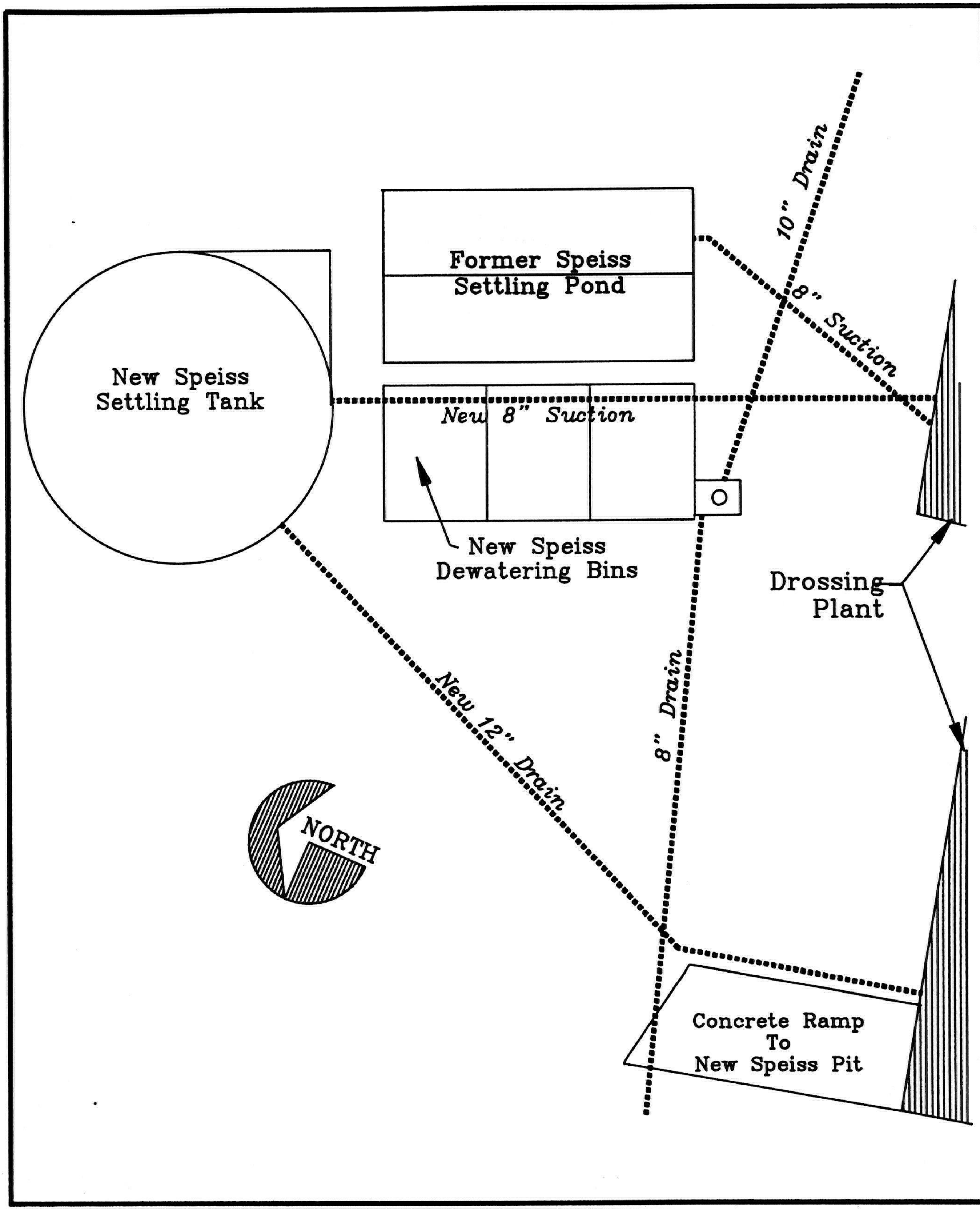


Figure 3–1: Speiss Pond and Pit Replacement Facility

Demolition of the Remaining Portion of the Former Speiss Granulating Pond

Demolition of the former speiss granulating pond will include removal of the geomembrane liner and breakup and removal of associated concrete. The geomembrane liner will either be decontaminated for reuse in the plant, or smelted.

Concrete removed from the remaining portion of the former speiss pond will be decontaminated by pressure washing. Representative samples of the removed concrete will be obtained in accordance with the RD/RA Sample and Analysis Plan (SAP) (see Section 7.1). Decontaminated samples will be sent to the Asarco Department of Environmental Services (DOES) laboratory in Salt Lake City for analysis using the EP Toxicity leachate procedure.

If EP toxicity testing indicates metals and arsenic concentrations of leachate from the concrete samples are not EP toxic, demolished concrete will be disposed as a solid waste in a local landfill, or stored on-site. The slag pile or, storage areas that contain soils excavated during construction of the ore storage and handling building and which also meet EP toxicity criteria are potential on-site disposal areas. If test samples are EP toxic, the demolished concrete will be smelted.

3.2 SPEISS GRANULATING PIT

The work plan for the speiss granulating pit requires two phases. Phase one involves immediate abatement for the speiss granulating pit by installing a leakproof liner, secondary containment, leak detection, and a recovery system. The second phase entails developing a design for a containment structure that will provide a permanent leakproof system. A permanent system will be RCRA compliant and include: a leakproof concrete structure with secondary containment, leak detection, and a recovery system.

Speiss Pit Temporary Containment

A temporary lining system will be composed of concrete with functional water stops. The concrete liner will be designed to resist cracking that may occur from the extreme heat involved in the granulating process. It will also include all of the functional components of the existing speiss pit to allow the drainage of fluids to the speiss ponds and removal of speiss to dewatering bins. This temporary system will be used to suppress additional leakage to the underground system while designs for a permanent structure are completed.

Demolition and Reconstruction of Speiss Granulation System

The work plan for the removal of the old speiss granulating pit and installation of a new granulator, built to RCRA standards, will be dependent on the location for the new granulator. Demolition of the old speiss granulation pit and removal of the contaminated soils around and beneath the pit would be conducted with regard to the existing buildings and structures. All excavation, wherever possible, would be in accordance with all other excavation protocol and procedures within this RD/RA work plan. Replacement of excavated soils will be accomplished using clean, uncontaminated backfill to a density suitable for the construction of the new speiss handling pit. At the present, plans regarding the design and location of the new speiss granulator which is to be constructed along with a new Dross Reverbatory furnace are uncertain since construction will not begin until the last quarter of 1992.

Materials removed shall be extremely segregated, decontaminated, and disposed of, or stored as outlined in this Work Plan. The excavation will then be backfilled with clean materials.

The new speiss handling pit will be constructed with a secondary containment system, leak detection, and leak recovery system. The new structure will be constructed of concrete with a sufficient thickness to prevent wastewater from seeping through the walls or slab of the facility. Sealed construction joints capable of resisting high temperatures also would be designed to allow the concrete to expand and contract without cracking, preventing the failure of the new structure.

Surrounding the new structure will be a secondary containment system. The system will be built of concrete or steel as needed by space and service requirements. A leachate collection system will drain wastewater that will drain from the main containment facility if a failure would occur. The detection/recovery system will be built to contain leakage and will include warning devices.

3.3 EXCAVATED SOIL HANDLING AND TREATMENT

Prior to soil excavation and subsequent to demolition of the remaining portion of the former speiss granulating pond and pit, soil core samples will be collected. EP toxicity testing will be conducted on collected soil cores to determine the depth and extent of excavation. Samples will be collected in 2 foot increments to a depth of 20 feet. A total of two bore holes will be completed in the area of the former speiss granulating pond. One bore hole will be completed in the speiss granulating pit area because of its limited size.

An alternative to bore hole sampling may be collection of samples from test pit excavations. Close access to existing facilities in the speiss granulating areas is limited and may prohibit bore hole drilling.

Soil sampling Standard Operating Procedures (SOPs), analytical procedures and protocol, and the quality assurance program for collection of soil sampling and analysis will be included in the SAP.

Excavation objectives will be set based on soil sample EP toxicity testing results. Soil leachate exceeding MCLs will be excavated. If all samples exceed the MCLs, soils will be excavated to the maximum practical limit of about 20 feet, which is the depth of the groundwater table. A five foot buffer zone around the perimeter of the demolished facilities will also be excavated where practical. Where existing structures and facilities preclude, a five foot buffer, as much buffer as possible, will be provided.

Excavated soils will be screened to separate cobbles, boulders and gravel from finer-grained soils. Soil that passes 1/2-inch screen will be stored and handled the same as ore concentrates and smelted. Gravel, cobbles and boulders that do not pass the 1/2-inch screen will be temporarily stored on a constructed dewatering platform and will be cleaned using pressure washing. Used wash water will be collected by the wash platform drainage system, and be incorporated in the main plant process circuit.

SOPs for soils excavation, gravel, cobble and boulder separation, and soil storage, handling and smelting are in Appendix 3-1.

4.0 ACID PLANT WATER TREATMENT FACILITY REMEDIAL DESIGN PLAN

The purpose of the acid plant water treatment facility is to reduce the solids content of the scrubber blowdown water and to treat and supply water to the sinter plant. Because of moisture in the atmosphere and feed stock, the scrubbers produce an excess of water. Part of this water is recirculated to the scrubbers; the remainder is neutralized and pumped to the sinter plant or recirculated to the acid plant. Main components of the acid plant water treatment facility are the dumpsters and the main settling pond, which provide gravity settling for blowdown water before it is neutralized and returned.

Under the selected alternative, the settling pond, dumpster system and settling drying area will be removed and replaced with an enclosed, above ground mechanical separation system. The new system will consist primarily of a filter press. Most of the filtrate water will be recirculated to the acid scrubbers, with a portion neutralized for use in the sinter plant. Scrubber makeup water will not need treatment beyond simple solids removal.

Underlying and adjacent soils will be excavated based on EP toxicity leaching tests conducted on soil cores. Excavation objectives are to remove soils with leachate that exceed MCLs, or to the maximum practical excavation limit. A 5-foot buffer zone outside of the perimeter of removed portions of the settling pond, dumpster system, and settling drying area will also be excavated.

Gravel, cobbles and boulders will be separated from the soil using a 1/2-inch screen, washed, and stored on-site in accordance with Section 3.3 of this Work Plan. Remaining soils will be smelted.

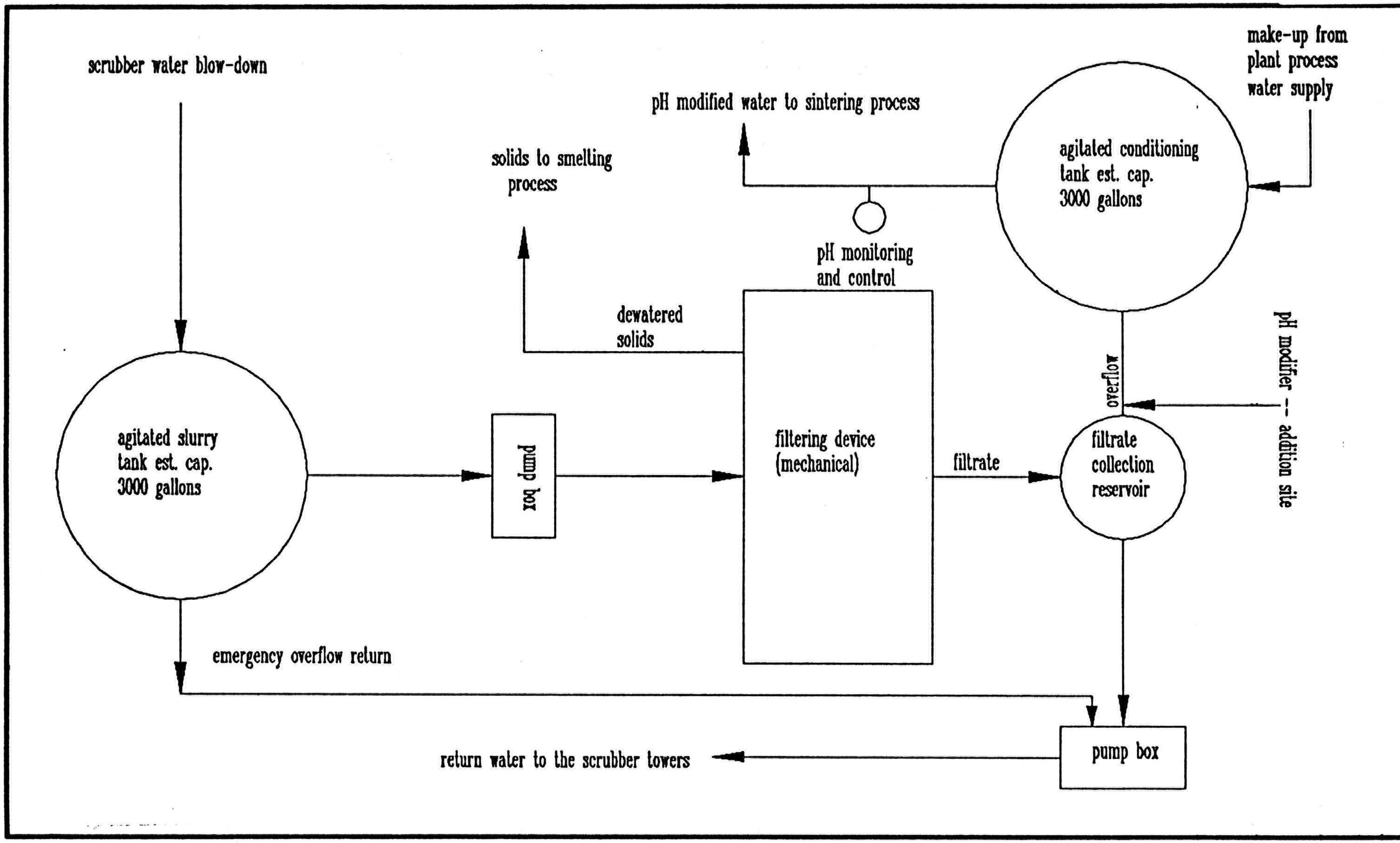
Lime will be added to the excavation prior to replacement with clean fill to reduce the mobility of arsenic and metals associated with soils underlying the acid plant water treatment facility.

4.1 ACID PLANT SCRUBBER WATER TREATMENT SYSTEM

The conceptual design for remediation of the acid plant water treatment facility consists of the following elements:

<u>Acid Plant Scrubber Water Treatment Plant</u>

- A conceptual design for the acid plant scrubber water treatment system is on Figure 4-1. This facility will consist of a slurry tank, a filter press, a filtrate collection reservoir, a conditioning tank and the necessary pumping accessories. Water from the scrubber towers will flow by gravity to the slurry tank. From the slurry tank, water and solids would be pumped to the filter press. An emergency overflow bypass line will be incorporated in the event of filter or filter pump failure. Water from the filter press will flow to the filtrate collection reservoir where a portion of the clarified water will be returned to the scrubbers with the balance to be pH adjusted for use in the sintering process.



DRAWN BY: TOM MCINTYRE
DATE: APRIL 27,1990

Figure 4-1: New Acid Plant Water Treatment Facility Conceptual Design

- Filter Press pilot plant scale tests were conducted in 1989. Based on the results of the tests, solids production is estimated to be 4850 lbs/day (dry basis). Filter cake moisture contents as low as 19.4% were obtained during the testing. The filter cake at that moisture content demonstrated that free draining of the moisture is not a problem. Therefore, the dewatered solids will be recovered from the filter press and stored in an open, water-sealed concrete bin until it can be returned to the smelting processes.

- Construction of the new acid plant water treatment plant must occur as the first step in the remediation of the existing acid plant water treatment facility. The proposed location for the new acid plant water treatment facility is northwest of the existing facility (see Figure 4-2).

- Facility Demolition

  The existing water treatment plant consisting of the dumpster system, the settling pond and associated facilities will be removed using standard operating procedures for demolition, decontamination, and storage outlined in Appendix 3-1 of the work plan. Soil will be excavated to target objectives, and replaced with clean backfill. After demolition, concrete, steel components, and miscellaneous items will be decontaminated and tested using the decontamination and storage procedures outlined in Appendix 3-1.

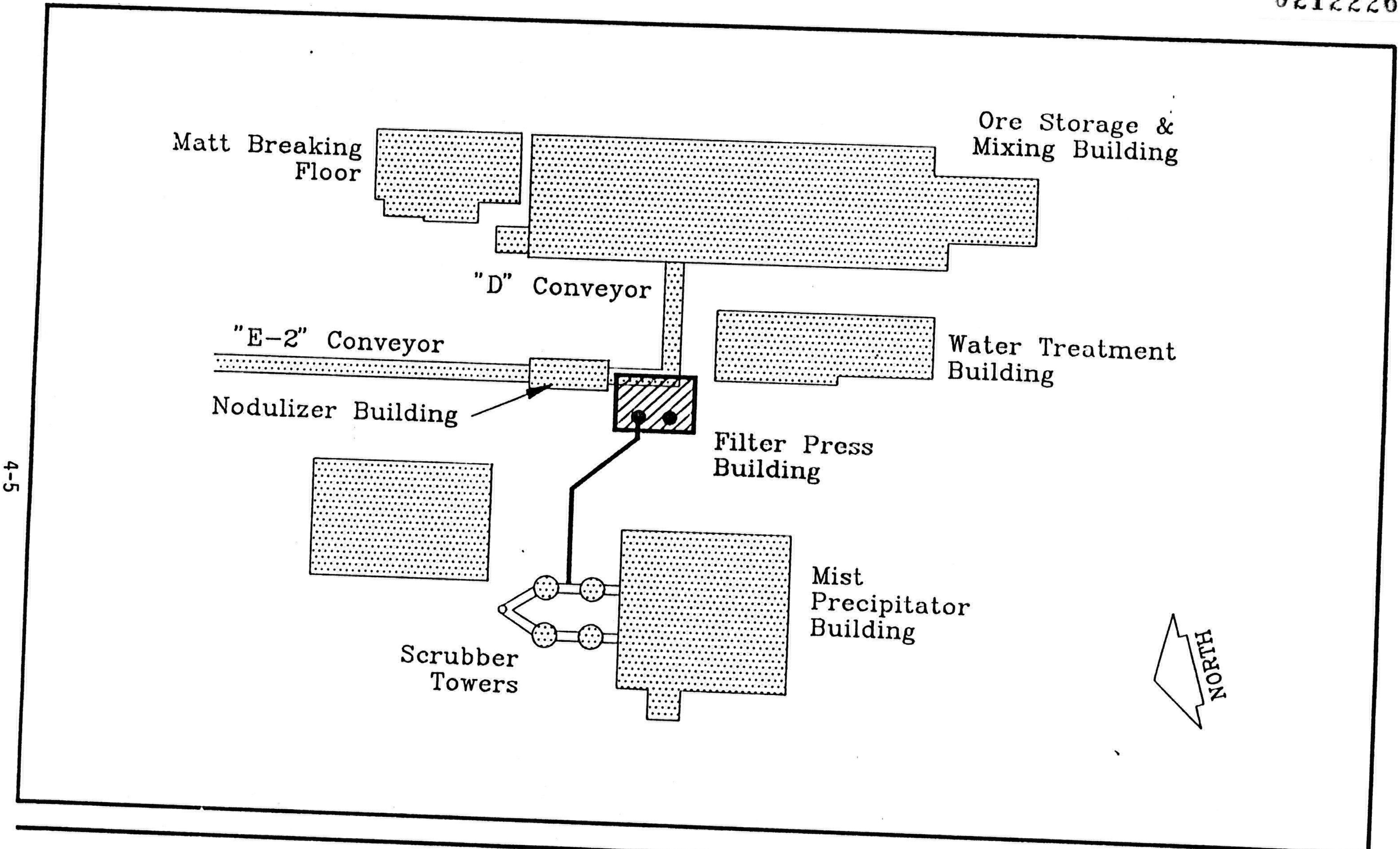


Figure 4.2
Location Plan Of The New Acid Plant Water Treatment Facility

4.2 EXCAVATED SOIL HANDLING AND TREATMENT

Prior to soil excavation and subsequent to demolition of the acid plant water treatment facilities and the sediment drying areas, soil core samples will be collected. EP toxicity testing will be conducted on collected soil cores to determine the depth and extent of excavation. Samples will be collected in 2 foot increments to a depth of 20 feet. A total of three bore holes will be completed in the acid plant water treatment area. Five bore holes will be completed in the sediment drying areas.

An alternative to bore hole sampling may be collection of samples from test pit excavations. Limited access close to the existing facilities in the acid plant water treatment area may prohibit bore hole drilling at this location.

Soil sampling SOPs, analytical procedures and protocol, and the quality assurance program for collection of soil sampling and analysis will be included in the Sample and Analysis Plan (SAP).

Excavation objectives will be based on soil sample EP leachate toxicity testing results. Soil leachate exceeding MCLs will be excavated. If all sample leachate exceed MCLs, soils will be excavated to the water table or a maximum practical limit of about 20 feet. A five foot buffer zone around the perimeter of the demolished facilities will also be excavated where possible. At locations where functioning facilities or structures prohibit excavation of a five foot buffer zone, as much soil as possible will be excavated.

Lime will be added prior to the excavation placement of fill to reduce the mobility of arsenic and metals associated with soil conditions underlying the acid plant water treatment facility and sediment drying areas. Treatability testing on soil samples will be required to assess proper application rates.

Excavated soils will be screened to separate gravel, cobbles and boulders from finer grained soils. Soil passing a 1/2-inch screen will be stored, handled and smelted in accordance with procedures established for other soils requiring treatment. Gravel, cobbles and boulders not passing the 1/2-inch screen will be temporarily stored on a constructed dewatering platform and will be cleaned using pressure washing. Rinse water will be collected by the wash platform drainage system, and will be incorporated in the main plant process circuit. SOPs for soils excavation, gravel, cobble and boulder separation, and soil storage, handling and smelting are in Appendix 3-1.

5.0 FORMER THORNOCK LAKE REMEDIAL DESIGN PLAN

The remedial actions for former Thornock Lake have already been implemented. The former pond was replaced by a RCRA type tank with secondary containment and leak detection. Sediments have been excavated and smelted.

6.0 CONTINGENCY REMEDIAL DESIGN PLAN FOR LOWER LAKE PROCESS WATER

The selected remedy for Lower Lake involves an innovative technology, involving in-place co-precipitation of arsenic and metals from Lower Lake process water. Pilot test results to date show co-precipitation exceeds treatment standards described in the ROD. However, pilot testing is yet to be demonstrated on a significant portion of the pond. Also, no pilot scale testing has been conducted to show the effects, if any, of sludge and sediment removal. It is possible sludge and sediment removal processes could reintroduce dissolved arsenic into Lower Lake process water which has already been treated to remove arsenic and metals.

If in-place co-precipitation of arsenic and metals is shown to be ineffective during the final phase of pilot testing using a portion of Lower Lake, then the contingency remedial design will be implemented. The contingency remedy will be identical to the selected remedy except Lower Lake water will be pumped to an on-site treatment plant for removal of arsenic and metals and then discharged to the East Helena Publicly Owned Treatment Works (POTW).

Elements of the remedial design plan are:

- Identification of POTW discharge standards

- Pilot plant testing of selected water treatment processes. Several manufacturers have small, pilot-scale water treatment plants available for rent or lease.

- Full-scale design of treatment facilities.

7.0 ADDITIONAL PLAN REQUIREMENTS

As described in Section 1.2, additional work plan documents to be completed and attached to this RD/RA work plan as Appendices are described below.

7.1 SITE HEALTH AND SAFETY PLAN

A site Health and Safety Plan (HSP) will be developed for protection and safety of personnel implementing remedial action. The HSP will contain community protection requirements, site emergency procedures, and telephone listing of key individuals. The HSP will be developed in coordination with Asarco plant medical and safety staff, and with appropriate Lewis and Clark County officials. When complete, the HSP will be included as part of this RD/RA Work Plan as Appendix 7-1.

7.2 SAMPLING AND ANALYSIS PLAN

A Sampling and Analysis Plan (SAP) which includes a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP) will be prepared. The plan will address sampling and quality assurance procedures for process water, sediment, soil and other media, as necessary.

The FSP will address sampling locations, procedures, protocols, analytical techniques, data validation procedures, and other elements, as necessary. The FSP will include sampling, and laboratory or field testing conducted as part of RD or RA activities. The FSP will address sampling for remedial design, remedial action, and post action monitoring.

The QAPP will be developed in accordance with CERCLA and the National Contingency Plan, will define data quality objectives for FSP tasks, and describe all procedures to assure sample and analytical quality. QAPP project organization and personnel responsibilities, including design and construction, will be established.

When complete, the SAP will be included in this work plan as Appendix 7-2.

7.3 CONSTRUCTION MANAGEMENT PLAN

A construction management plan will be prepared for incorporation as part of remedial design. The plan will include procedures for project communication, documentation, record keeping, schedules and criteria for site meetings, change order requirements, daily operating logs, project schedules and milestones, emergency procedures, and other elements as necessary for effective and efficient construction management. When complete, the Construction Management Plan will be included in this RD/RA Work Plan as Appendix 7-3.

7.4 LOWER LAKE PROCESS WATER PILOT TESTING DESIGN PLAN

This plan was prepared by Hydrometrics and approved by EPA in December 1989. The pilot testing program was initiated in February and March. Testing completion is expect in April with full testing results presented in the Pilot Testing Results Report in June 1990.

7.5 DESIGN PLAN FOR SEPARATION OF GRAVEL, COBBLES AND BOULDERS FROM EXCAVATED SOILS

This plan presents disaggregation procedures for soils excavated from the acid plant and speiss granulating pit and pond areas. The plan will include an evaluation of the size fraction that will require smelting, handling of large aggregate, required equipment, and implementation schedule. This plan will be included in Appendix 7-5.

7.6 SMELTER TREATMENT DEMONSTRATION DESIGN PLAN

The Smelter Treatment Demonstration Design Plan will consist of a detailed outline of objectives and procedures for conducting a demonstration of smelting soils and sediment. The Plan will include site-specific demonstration of contaminants in soils and sediment, and will include pre-smelting and post-treatment laboratory analyses.

7.7 OPERATIONS AND MAINTENANCE PLAN

An Operations and Maintenance (O & M) Plan will be prepared to identify the generic elements as well as provide a guideline for detailed specific O & M Plans for each remedial design component.

8.0 REMEDIAL DESIGN REPORTS

The following remedial design reports will be prepared and submitted to EPA and DHES:

- Lower Lake Process Water Pilot Test Reports
- Smelter Demonstration Report
- Preliminary Overall Design Report
- Prefinal Overall Design Report
- Final Design Report
- ARARs Report

9.0 REMEDIAL ACTION ACTIVITIES

Remedial action activities will be conducted in accordance with the ROD, as well as other plans that are consistent with the ROD. These include:

- Development and implementation of a Construction Quality Assurance (CQA) Plan
- Preconstruction inspections and meetings with contractors, EPA, officials, DHES officials, and local authorities to review, report and documentation methods, work area security and safety protocols, and conduct site inspections to verify understanding of design criteria, plans and specifications, and review material/equipment storage locations.
- Construction of temporary storage unit for excavated sediment and soils
- Monitoring of remedial actions
- Operation and Maintenance of implemented remedies
- Prefinal construction conferences and inspections to assure compliance with project plans and consistency with the ROD
- Final construction conferences and inspections to assure all objectives are achieved
- Construction Completion Reports
- Five-Year Review Reports.

10.0 RD/RA PROJECT PERSONNEL, QUALIFICATIONS AND ORGANIZATION

Primary Process Ponds RD/RA project organization and key personnel are shown in Figure 10-1. Since this is an operating facility, remedial design and remedial action require significant input from and coordination with Asarco plant operating personnel.

Mr. Jon Nickel will continue to be Asarco's East Helena project administrator. Bob Miller and Bob Braico from Hydrometrics will be technical project managers for the Process Ponds RD/RA project. Bob Miller was the Process Ponds RI/FS project manager and will continue management and coordination activities for the East Helena Site. Bob Braico is the Senior Engineer at Hydrometrics and designed and conducted the Lower Lake Pilot Testing Program.

The RD/RA project will also include key Asarco plant operating personnel to coordinate RD/RA implementation with plant operations. Additional key project technical personnel will be obtained from appropriate contractors in accordance with project requirements.

The general project organization schematic (Figure 10-1) will be updated as RD/RA contractors are obtained for the project, and as additional personnel are assigned. In addition, related work plans, which will be completed as appendices to this RD/RA Work Plan (See Section 7.0), will include detailed project personnel, responsibilities and organization information.

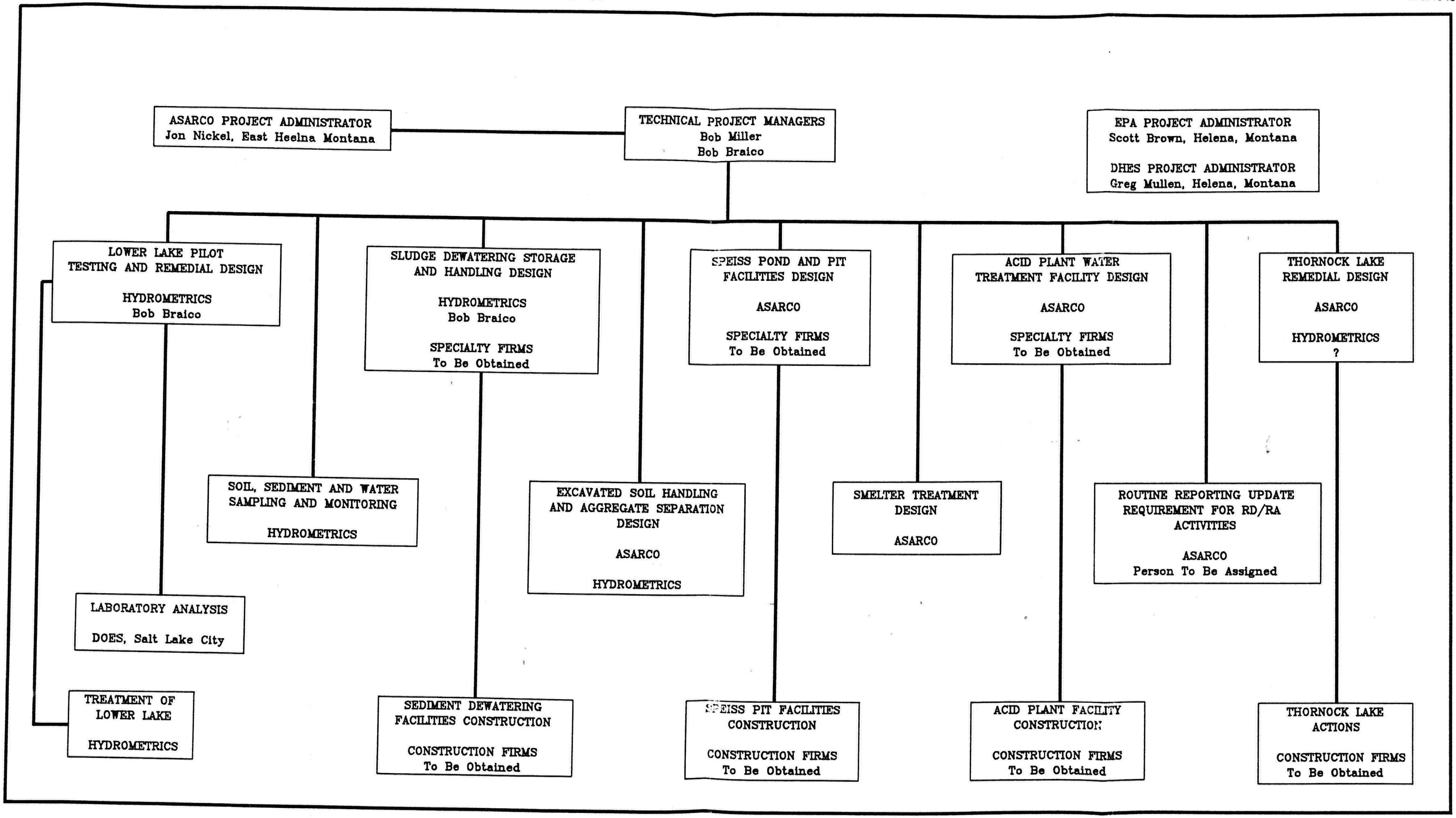


Figure 10–1: RD/RA General Personnel and Organizational Chart

11.0 SCHEDULE

Many elements of the RD/RA Work Plan are interrelated. RD/RA activity time schedules are shown in Table 2.

Schedule alterations associated with implementation of the contingency remedy (treatment plant for Lower Lake process waters) are also shown.

Table 2 PROCESS PONDS REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN SCHEDULE

DELIVERABLE/MILESTONE	DATE DUE
Consent Decree Negotiation:	
Special Notice Letter, Draft Consent Decree and SOW	February 23, 1990
Process Ponds RD/RA Work Plan - Draft	May 1, 1990
Negotiations (up to 120 days after special notice)	June 29, 1990
Procurement of Remedial Design Contractor(s)	September 3, 1990
Attachments to Process Ponds RD/RA Work Plan	
Health and Safety Plan (HSP)- Draft	August 1, 1990
EPA Comments on draft HSP Revisions and Final HSP	August 22, 1990 October 15, 1991
Sampling and Analysis Plan (SAP)- Draft	August 1, 1990
EPA Comments on Draft SAP Revisions and Final SAP	August 22, 1990 October 15, 1991
Lower Lake Process Water In Situ Pilot Scale Testing Plan - Draft and Final	Already Completed and Approved by EPA
Lower Lake Process Water Contingent Remedy Pilot Test Plan - Draft	Schedule depends on In Situ Testing Results
EPA Comments on Draft Revisions and Final	
Smelter Treatment Demonstration Design Plan	September 3, 1990
EPA Comments - Draft Demonstration Plan Final Smelter Demonstration Plan	September 24, 1990 October 13, 1990

Table 2 (continued) PROCESS PONDS REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN

DELIVERABLE/MILESTONE	DATE DUE
Reports and Demonstrations:	
Lower Lake In Situ Process Water Pilot Scale Testing Reports	
Interim Report	May 15, 1990
Final Report	August 1, 1990
EPA Comments	September 15, 1990
Lower Lake Contingency Remedy Pilot Scale Test, if necessary	
Interim Report	90 Days After EPA Approval of Testing Plan
Final Report	180 Days After EPA Approval of Testing Plan
EPA Comments	45 Days After Submittal of Final Report
Smelter Treatment Demonstration Report	November 26, 1990
EPA Comments	December 17, 1990
Review/Approval	February 18, 1991

Table 2 (continued) PROCESS PONDS REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN

DELIVERABLE/MILESTONE	DATE DUE
Remedial Designs for Demolition, New Construction, Sediment and Soil Excavation, Sediment Drying Facilities Construction, Soil and Sediment Storage Facilities, Reduction of Process Circuit Gains	
Preliminary Design Reports	April 1, 1991
EPA Comments	May 1, 1991
Prefinal Design Reports	July 29, 1991
EPA Comments	September 9, 1991
ARARs Report	July 29, 1991
EPA Comments	September 9, 1991
Revision and Final	October 30, 1991
Final Design Report	December 1, 1991
EPA Comments	December 22, 1991
Revision of Final Design Report	February 15, 1992
Review Approval	March 15, 1992

Table 2 (continued) PROCESS PONDS REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN

DELIVERABLE/MILESTONE	DATE DUE
Remedial Design for Lower Lake In Situ Treatment	
Preliminary Design Report	September 28, 1990
EPA Comments	October 29, 1990
Prefinal Design Report	February 28, 1991
EPA Comments	April 1, 1991
ARARs Report	April 30, 1991
EPA Comments	May 21, 1991
Revisions and Final	June 21, 1991
Final Design Report	September 1, 1991
EPA Comments	October 1, 1991
Revision of Final Design Report	November 15, 1991
Review Approval	December 15, 1991

Table 2 (continued) PROCESS PONDS REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN

DELIVERABLE/MILESTONE	DATE DUE
Remedial Design for Contingency Treatment of Lower Lake	Dates are dependent on the evaluation of the in situ testing results and would not be initiated if in situ treatment is successful.
Preliminary Design Report	180 days after in situ testing report.
EPA Comments	30 days after submittal.
Prefinal Design Report	90 days after comments
EPA Comments	45 days after submittal
ARARs Report	With Prefinal Design
EPA Comments	30 days after submittal
Revision/Final	45 days after comments
Final Design Report	90 days after pre-final review comment
EPA Comments	45 days after submittal
Revision of Final Design Report	60 days after comments
Review Approval	21 days after comments

Table 2 (continued) PROCESS PONDS REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN

DELIVERABLE/MILESTONE	DATE DUE
Operations and Maintenance Plans for Excavated Sediment and Soil, and Lower Lake Process Water Remedy Designs	Dates are contingent on completion of construction.
Submittal	At completion of construction.
EPA Comments	45 days after submittal
Revisions/Final	60 Days after comments
EPA Approval	21 days after submittal
Sampling and Analysis Plan for Sediment and Soil, and Lower Lake Remedy Designs.	
Submittal	August 29, 1991
EPA Comments	October 15, 1991
Revisions/Final	December 1, 1991
EPA Approval	December 22, 1991
Construction and Management Plan for Excavated Sediment and Soil, and Lower Lake Remedy Designs	
Submittal	August 29, 1991
EPA Comments	October 15, 1991
Revisions/Final	December 1, 1991
EPA Approval	December 22, 1991

APPENDIX 3-1.

RD/RA STANDARD OPERATING PROCEDURES

HYDROMETRICS HELENA, MT

STANDARD OPERATING PROCEDURE

EXCAVATION
(HFOP-64-05/90)

Excavation for the removal and replacement of soils from designated area shall follow the outline noted below:

1) Clear all debris remaining from demolition.

2) Define limits of excavation, fencing off or barricading area as required by OSHA safety requirements.

3) Commence excavation of the area by removing material in 2′ layers or at a depth thinner or thicker that allows the testing for limits of contaminated materials.

4) For unstable banks and excavations deeper than 5 feet, provide trench support to prevent bank cave-ins and sluffing. Foundation integrity and support for adjacent structures shall be maintained during the excavation by providing trench shoring for the excavation, as required.

5) Remove material to a depth as determined by soil borings or to the maximum practical limit. Excavate ramps and landings as necessary for equipment to access the limits of the excavation.

6) At completion of the excavation, decontaminate equipment as outlined in the SOP for Decontamination of Construction Equipment.

7) Replace excavated soils with select backfill as described in the SOP for Soil Replacement (HFOP-67-05/90). Backfill materials to be tested in accordance with the LAP for the East Helena Site.

HYDROMETRICS HELENA, MT

STANDARD OPERATING PROCEDURE

DEMOLITION
(HFOP-65-05/90)

Structures designated for removal shall be removed following procedures outlined below:

1) Determine which structures are to be removed. Take samples following the SOP for the materials to be tested.

2) Prepare area for demolition. Barricade work area and provide signs and implement other OSHA safety precautions.

3) Strip, rip, pulverize, and break down structure to the sizes required for removal. Segregate portions of the structure to be decontaminated. Dispose of material by smelting or other approved method. Place portions of the structure not requiring decontamination in designated disposal area.

4) Clean up the site by removing all material remaining from the demolition. Grade the site as required.

5) At completion of the demolition, move equipment to decon area. Decontaminate equipment as outlined in the SOP for Decontamination of Construction Equipment and Demolition Materials (HFOP-66-05/90).

Concrete, steel, timber and other demolition materials will be decontaminated in accordance with the SOP for decontamination of equipment and demolition materials (HFOP-66-05/90).

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HYDROMETRICS HELENA, MT

STANDARD OPERATING PROCEDURE

DECONTAMINATION OF EQUIPMENT AND DEMOLITION MATERIALS
(HFOP-66-05/90)

Equipment used in removal of structures and structural material determined as EP Toxic shall be decontaminated using the following procedure. Equipment to be decontaminated shall include hand tools; light pneumatic, hydraulic, and motor driven tools; and heavy machinery. Demolition materials to be decontaminated using this procedure shall consist of concrete, structural steel, timbers and other non-soil materials such as siding.

1) Equipment used in the demolition and removal of soil materials and structures shall undergo primary cleaning at the site of use. Primary cleaning shall consist of removal of large clods of material with a shovel or pry bar. Material removed shall be disposed of in the same manner as soils or other debris.

2) At the completion of the primary cleaning, equipment will be moved to the designated decon platform. Equipment shall be pressure washed to remove fine-grained materials. The decon area shall have a nonpermeable surface to prevent infiltration of wastewater.

3) Washwater and particulates from the decontamination operation will be collected in a lined sump where particulates will be allowed to settle out. Clarified washwater will be pumped from the sump and either introduced into the process water circuit or routed to the stormwater runoff holding pond and evaporated. Sediments will be removed to the ore storage building for eventual smelting.

HYDROMETRICS HELENA, MT

STANDARD OPERATING PROCEDURE

SOIL REPLACEMENT
(HFOP-67-05/90)

Excavations from which contaminated materials have been removed shall be backfilled following the procedures outlined below:

1) Clean backfill material shall be imported for backfilling excavations. If stockpiled, the fill shall be placed in the designated area for backfill stock pile.

2) Equipment for proper processing, placement, and compaction of backfill shall be on-site before backfilling excavations. Material shall be placed in layers and be compacted as specified in the project specifications.

3) Backfilling shall continue until the excavation is filled to the same elevations as the surrounding surfaces or to the designated elevation.

4) At the completion of the backfilling operation, equipment shall be decontaminated using the SOP for Equipment Decontamination (HFOP-66-05/90).

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APPENDIX 7-1.

SITE HEALTH AND SAFETY PLAN

APPENDIX 7-2.

SAMPLING AND ANALYSIS PLAN

APPENDIX 7-3.

CONSTRUCTION AND MANAGEMENT PLAN

APPENDIX 7-4.

LOWER LAKE PROCESS WATER PILOT TESTING PLAN

APPENDIX 7-5.

DESIGN PLAN FOR SEPARATION OF COBBLES

FROM EXCAVATED SOILS

APPENDIX 7-6.

SMELTER TREATMENT DEMONSTRATION DESIGN PLAN

0212256

APPENDIX 7-7.

OPERATION AND MAINTENANCE PLAN

0212257

APPENDIX 10-1.

RESUMES OF KEY PERSONNEL AND ORGANIZATIONS

PROFESSIONAL QUALIFICATIONS

ROBERT J. MILLER

EDUCATION

University of Wisconsin - Oskhosh, Oshkosh, WI 1978, B.S. Geology

EXPERIENCE

HYDROGEOLOGIST, July 1980 to present. Responsible for management and implementation of hydrogeological investigations for groundwater pollution studies, water development projects, baseline studies and permit applications. Current responsibilities include project management of a water resources contamination and remedial action investigation/feasibility study at a CERCLA site at the ASARCO Smelter in East Helena, Montana; project management of water resources monitoring; baseline and water development investigations for a major hard rock mine near Zortman, Montana, and remedial investigation of heavy metals and organic contaminants at a potential CERCLA site near Butte, Montana. Other major projects included groundwater study of oil wastes at Exxon Refinery hazardous waste sites, including test drilling, data analysis and preparation of permit information; groundwater investigation of petroleum product contamination at sites in Dillon, Great Falls and Helena, Montana; investigation and monitoring of water resources at a CERCLA hazardous waste site in Leadville, Colorado; field investigation of creosote contamination of surface water and groundwater at two former railroad tie plants in northwestern Montana; monitoring and baseline investigation at four large coal mines in eastern Montana; and development of several water supplies for industries and communities. Other duties have included development of monitoring programs at hazardous waste sites, solid waste sites, aquifer flow simulations, aquifer testing, drilling and installation of monitoring wells, water quality monitoring and development of contaminant spill contingency plans. HYDROMETRICS, INC., 2727 Airport Road, Helena, MT 59601

GEOLOGIST AND SOILS TECHNICIAN, June 1979 to May 1980. Responsibilities included field investigations and identification of soil and rock samples, resistivity surveys for commercial gravel properties, and field and laboratory testing of soil prior to and during construction projects. SOIL TESTING SERVICES OF WISCONSIN, 9055 North 51st Street, Milwaukee, WI.

HYDROGEOLOGIST/GEOLOGIST, May 1978 to March 1979. Project coordinator and field engineer for hydrology investigation of a uranium mine in southern Colorado including aquifer testing and evaluation, coordination of major drilling programs, mapping and analysis of subsurface hydrology and geology, drainage basin investigations, water monitoring and sampling program and hydrologic investigations for residential and municipal development. Other projects included investigation of a major fuel spill into groundwater in Montevista, Colorado, and design and implementation of a recovery system. Experience included geologic and geophysical log analysis and interpretation, design construction and development of piezometers and pumping wells, and installation and maintenance of surface water projects. WRIGHT WATER ENGINEERS, INC., 2420 Alcott Street, Denver, CO 80211.

PROFESSIONAL AFFILIATIONS

National Water Well Association

PROFESSIONAL QUALIFICATIONS

ROBERT D. BRAICO

EDUCATION

Montana State University, 1968, B.S. in Civil Engineering
Montana State University, 1972, M.S. in Civil (Environmental) Engineering

REGISTRATION AND LICENSES

Registered Professional Engineer: Montana, Wyoming

EXPERIENCE

VICE-PRESIDENT - ENGINEERING - 1979 to Present. Responsible for technical and administrative management of a number of projects including a PCB site investigation at a former electrical repair facility; design of geotextile fabric reinforced soil walls; design of a gasoline contamination groundwater interception system; reclamation design of abandoned coal mines near Dillon, MT; design of storm drain facilities at a lead refinery in Nebraska; examination of hazardous wastes landfill alternatives at a superfund site near Tacoma, WA; a hydrologic assessment and development of engineering alternatives for treatment of metals contaminated groundwater for a portion of the Silver Bow Creek Superfund site in Butte, MT; design of diversion, pumping and pipeline facilities at two major hard rock mines in Montana; examination of poor industrial wastewater treatment plant performance and development of remedial measures to correct treatment plant metals removal deficiencies at a closed zinc refinery in central Ohio; development of engineering plans and specifications for reclamation of selected inactive mine sites in Butte, Montana; investigation of hydrological impacts and water supply requirements for several hard rock mines in western Montana; study of hydrological and geological conditions, site selection and engineering design of hazardous wastes landfill facilities at the Columbia Falls Aluminum Company reduction plant near Columbia Falls, MT; completion of a ten volume report on the environmental impacts of and reclamation alternatives for over one-hundred years of mining in the Butte, Montana area; examination of environmental impacts of a proposed gold mine using cyanidization for gold recovery; monitoring of hydrological impacts due to subsidence of a major underground coal mine in central Utah; and a baseline water resources study of a proposed major strip coal mine in eastern Montana. Other projects in which he has had a major role are drainage and sediment pond design for a major strip coal mine, evaluation of water resources impacts of the Anaconda Copper Company smelter, plus work on numerous water and wastewater problems for private and industrial organizations. HYDROMETRICS, INC., 2727 Airport Road, Helena, MT 59601.

Robert D. Braico, continued

HEAD-DISCHARGE PERMIT, ENFORCEMENT AND COMPLIANCE SECTION - June 1978 to September 1979. As head of the water pollution control enforcement section, was responsible for administration of Montana's water pollution control laws which included the Montana Pollutant Discharge Elimination System. Major program elements included development and renewal of wastewater discharge permits and related documents for the proposed ASARCO underground mining complex in northwestern Montana, for the Johns-Manville Sales Corporation exploration adit in south-central Montana, for the Anaconda Copper Company's Minneapolis Adit, and for several strip coal mines in southeastern Montana. During this time, Mr. Braico also served as a Department representative in providing review and comment on the Anaconda Copper Company's Clark Fork River study and conducted an investigation of the Milwaukee Railroad Company's diesel spill and subsequent shallow groundwater contamination at Miles City, Montana. Other major program elements included design review of numerous proposed industrial wastewater treatment facilities, preparation and presentation of testimony in litigation involving Montana's Water Quality Act, coordination of State emergency response for oil and hazardous materials spills, review of major industrial and municipal wastewater treatment facilities and administration of the Montana Pollutant Discharge System Permit Compliance Monitoring Program.

SANITARY ENGINEER III- July 1975 to June 1978. Primarily responsible for coordination of Montana sewage treatment plant operations and maintenance inspection program; operation and maintenance evaluations of community water and sewage treatment systems, and reviewing of reports, plans and specifications for community water and sewer systems. Other responsibilities included investigating water pollution complaints; reviewing federal and state environmental impact statements for water quality impacts; coordination of emergency response for oil and hazardous materials spills; 1977 director of Montana water and wastewater operators school; and participation in the Department's thermal study of the Yellowstone River near Billings. A significant project completed while in this position was developing of data and the preparation and presentation of testimony for the Water Quality Bureau's Yellowstone River flow reservation request. MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES, WATER QUALITY BUREAU, Helena, Montana, 59601.

PUBLIC HEALTH ENGINEER II - January 1972 to July 1975. Responsible for planning, data collection and writing water quality management plans for the Missouri River drainage from the headwaters downstream to Canyon Ferry Reservoir and from Canyon Ferry Reservoir downstream to the Marias River confluence. These water quality management plans were conducted under the Federal Water Pollution Control Act to inventory surface water quality in the drainage and to provide a

Robert D. Braico, continued

preliminary evaluation of the impacts of municipal, industrial and agricultural discharges to streams in the study areas. He was also responsible for initial planning and data collection for the upper Clark Fork River drainage water quality management plan. Other responsibilities included completion of a low-flow temperature and dissolved oxygen study of the Clark Fork River, investigation of mining impacts to stream systems in the Tobacco Root Mountains and in the Boulder River drainage of southwestern Montana, investigation of water pollution complaints, review of plans and specifications and operations and maintenance evaluations for community sewer and water systems. A major task completed was development of the area-wide 208 water quality management program plan for the Gallatin and Madison River drainages (Montana) which was submitted to and approved by EPA. This resulted in the formation of a local EPA funded planning agency (Blue Ribbons of the Big Sky APO). MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES, WATER QUALITY BUREAU, Helena, MT., 59601.

CIVIL ENGINEER - October 1968 to September 1970. Entered a three-year engineer training program. Responsible for project funding and administration; storm and sanitary sewer design; street design, traffic planning and facilities maintenance. Major accomplishments included designing and development of plans and specifications for sewer and street projects. CITY OF ST. PAUL, MINNESOTA, DEPARTMENT OF PUBLIC WORKS, City Hall, St. Paul, Minnesota.

NAVAL ARCHITECT (Structural Engineer) - June 1968 to October 1968. Responsible for design of modifications to surface vessels. U. S. NAVY, PUGET SOUND NAVAL SHIPYARD, STRUCTURAL/HULL DIVISION, Bremerton, Wash.

PROFESSIONAL AFFILIATIONS

Montana Water Pollution Control Federation
Water Pollution Control Federation

PUBLICATIONS

Water Quality Bureau, 1974. Oil Spill and Hazardous Materials Spill Contingency Plan, Montana Department of Health and Environmental Sciences.

Braico, R. D. and M. K. Botz, 1974. Water Quality Inventory and Management Plan - Upper Missouri Tributaries Basin, Montana. Water Quality Bureau, Environmental Sciences Division, Montana Department of Health and Environmental Sciences.

Robert D. Braico, continued

Braico, R. D. and M. K. Botz, 1974. Water Quality Inventory and Management Plan - Missouri-Sun-Smith Basin, Montana. Water Quality Bureau, Environmental Sciences Division, Department of Health and Environmental Sciences.

Braico, R. D. and M. K. Botz, 1974. Appriaisal of Water Quality in the Boulder River Drainage and Potential Methods of Pollution Abatement or Control. Water Quality Bureau, Environmental Sciences Division, Montana Department of Health and Environmental Sciences.

Braico, Robert D., 1973. Dissolved Oxygen and Temperature Diurnal Variations in the Clark Fork River between Deer Lodge and Superior, Montana. Water Quality Bureau, Environmental Sciences Division, Montana Department of health and Environmental Sciences.

Author of numerous private reports on water supply, water quality, wastewater treatment and water pollution.